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May 16, 2018

Subject: Draft Responses to EPA and WDNR Comments on *Draft Passive Arsenic Sampling Pilot Test Work Plan and Alternatives Evaluation*, EPA RCRA Administrative Order Docket No. RCRA-05-2009-0007 Tyco Stanton Street Facility; EPA ID No. WID 006 125 215

Dear Mr. Neal,

Tyco Fire Products LP (Tyco) has prepared this correspondence in response to the U.S. Environmental Protection Agency (EPA) and Wisconsin Department of Natural Resources (WDNR) comments on the document referenced above. The comments were provided in a document attached to an email delivered on April 26, 2018. An additional general comment was provided in an email delivered on May 10, 2018.

Based on the comments received regarding the conceptual proposed full-scale passive arsenic sampling, Tyco also is providing additional background regarding the objectives of the proposed passive arsenic sampling in evaluating vertical barrier wall (VBW) effectiveness. The role of the VBW is to contain onsite groundwater impacted with arsenic to the maximum extent practicable (as stated in the February 2009 *Administrative Order on Consent* [AOC] between EPA and Tyco).

The 2009 AOC required a Containment Barrier Monitoring and Sampling Plan to assess the effectiveness of the VBW. The 2011 *Barrier Wall Groundwater Monitoring Plan* (BWGMP; CH2M 2011) included the following activities to evaluate VBW effectiveness:

- Collect semiannual groundwater elevation data
- Collect annual groundwater samples for total arsenic
- Inspect the well network during each groundwater elevation event
- Resurvey the wells every 5 years

Surveys and visual inspections from both the land and water sides of the VBW also are conducted in accordance with the *Operation and Maintenance Plan, Revision 1 for Onsite Groundwater Management, September 2010* (CH2M 2010). Annual barrier wall monitoring reports have been submitted for data collected since 2011 and have indicated that the VBW is meeting the objective stated in the AOC.

The April 23, 2014 *Agreement on Resolution of 2013 Five-Year Review Technical Issues* (AOR) included an agreement to implement multiple additional activities to enhance the protectiveness of the site remedy that included:

1) Implement a pump down program in the former 8th Street Slip and former Salt Vault areas to reduce water levels below those of the ordinary low water level of the river.

2) Calculate the potential amount of groundwater migration from the upland area that could impact the ability of the river sediment to maintain the 20 parts per million (ppm) remedial action objective.

3) Conduct a groundwater dye test in the Main Plant Area adjacent to the VBW to determine if any portions of the wall in this area are found to be *visibly leaking* below the water line. It also was agreed that, if in subsequent Five-Year Reviews sediment sampling confirms that there are no arsenic concentrations in river sediment exceeding 20 ppm and the wall inspections confirm that there are no visible leaks or deflections, then additional dye testing will not be required.

4) Collect and analyze four sediment samples outside the Main Plant Area along the main channel and eleven sediment samples in the Turning Basin.

A *Barrier Wall Groundwater Monitoring Plan Update* (BWGMPU) (CH2M 2014) was submitted in June 2014 that included the plans for Items 1, 2, and 4 above. The BWGMPU included enhancements to the VBW monitoring (beyond those in the AOR) that included:

- Quantitative analysis of the river water during the dye test to assess dye presence/absence at concentrations below the visible range (note, this is beyond the scope of the AOR-stipulated dye testing requirement). Dye would be injected at nine locations along the VBW in the Main Plant Area, and the river would be monitored for several months for dye presence.
- Use of transducers to monitor groundwater elevations and hydraulic head differences between the contained areas, uncontained areas, and the river.
- Optimized monitoring well network.

Based on 47 comments provided by the agencies, which included numerous requests beyond the scope of the AOR (such as bedrock monitoring wells in the river, underwater sheet pile inspections, dye testing in the former Salt Vault and 8th Street Slip areas, additional monitoring wells along the sheet pile wall, and additional sediment samples), Tyco agreed to additional activities, beyond those required in the AOR, in a *Final Revision 2- BWGMPU* (CH2M 2015) submitted in September 2015 that included:

- Adjustment of sediment sample locations agreed to in the AOR and addition of 3 additional sediment sampling locations beyond those agreed to in the AOR, for a total of 18 sediment sample locations.
- Installation of an additional seven overburden and four bedrock monitoring wells along the sheet pile wall.
- Separately, Tyco agreed to conduct an evaluation of the site outfalls and implemented improvements to reduce the infiltration of arsenic-impacted groundwater into the outfalls and subsequent discharge into the river.
- Additional dye testing program revisions, as described below.

Subsequently, WDNR raised concerns in the comments received on the BWGMP regarding the concentrations of dye necessary for injection and the potential high concentrations of dye that might migrate into the river if there was a substantial seep through the wall. The parties recognized that it was not feasible to assess the entire Main Plant Area VBW using dye injections and that the dye testing would only assess a representative portion of the Main Plant Area VBW. At the request of WDNR, pilot dye testing was conducted in fall 2017 consisting of controlled dye releases to the river to measure river dispersivity. The pilot dye testing results indicated that dye testing would be difficult to implement given the high degree of dilution by the river, and CH2M recommended that dye testing not be pursued as indicated in the November 17, 2017 CH2M technical memorandum.

In December 2017, the parties agreed to evaluate alternatives to dye testing, and CH2M presented its recommended dye testing alternative (passive arsenic sampling) at a February 14, 2018

meeting. Tyco agreed at this meeting to also conduct pore water sampling using passive arsenic samplers, even though such testing was not required as part of the AOR or a component of the BWGMPU.

Tyco considers the proposed passive arsenic sampling to be a component of a multipronged VBW assessment program. Water level monitoring of groundwater levels inside the contained areas and surface water and groundwater levels outside the contained areas are assessed to determine if potential hydraulic connections exist between the two sides of the VBW. Periodic groundwater sampling for arsenic provides an indication of whether apparent migration of arsenic-impacted groundwater across the VBW (or through the underlying glacial till) is occurring. VBW inspections and surveys provide an indication whether the VBW has shifted or any observable changes or integrity concerns have arisen. Furthermore, the bulk sediment sampling to be implemented later in 2018 will provide an ultimate measure of VBW effectiveness by assessing whether sediments remain below 20 ppm. Additionally, surface water sampling conducted as part of monitoring for outfall evaluation and ultimately the treatment plant discharge permit has indicated that arsenic concentrations in surface water are below the EPA maximum contaminant level and acute and chronic surface water criteria. Passive arsenic sampling on the wall and river bottom, with follow-up surface water sampling if necessary, will provide additional data to evaluate VBW effectiveness for potential through-wall or under-wall migration pathways. These data will be evaluated together in the upcoming Five-Year Review to assess VBW effectiveness and identify next steps if issues are identified.

For ease of review, the EPA and WDNR comments are presented in italics followed by the Tyco draft responses in plain text. Responses to comments will be finalized following discussion at the May 16, 2018 meeting between the parties.

General Comments

The Agencies are concerned with the Vertical Barrier Wall (VBW) coverage outlined in the conceptual full-scale passive sampler testing. EPA expressed in the February 14, 2018 meeting that Tyco is expected to test for leaks along 15% of the VBW seams/joints. Previously, Tyco had estimated that the dye test would cover 27-28% of the VBW, depending on injection variables (CH2M Hill, 2015). Tyco's full scale DGT proposal involves deploying five DGT samplers with 6-inch exposure windows on 33 seams (10% of the 330 seams located on the 1,518 foot VBW in the Main Plant). Assuming the average height of the VBW under the river stage is 35 feet (420 inches), there are approximately 138,600 inches of seams where groundwater may be leaking to the river (seam height of 420 inches X 330 seams). Tyco's full-scale proposal would monitor 0.7% of the total seam length along the VBW in the Main Plant (6-inch exposure window per DGT X 5 DGTs per seam X 33 seams with DGTs deployed = 990 inches; 990 inches / 138,600 inches = 0.007). In order for the full-scale test to be approved, Tyco must meet EPA's goal of monitoring 15% of the VBW.

The agencies requested density of diffusive gradient in thin film (DGT) passive arsenic samplers is impracticable and excessive for the following reasons:

- 15% coverage of the VBW was not agreed to in the AOR and appears to be an arbitrary value.
- Of the 35-foot depth of the VBW assumed by EPA, only 15 to 20 feet of the VBW is exposed to the river; the remainder is buried in the subsurface. The agreed-to alternative in the AOR was dye testing, which would have only been visible/detectable in the portion of the VBW in the river column; therefore, Tyco believes that any standard for coverage should be limited to that portion exposed to the river water column (that is, 15 to 20 feet). Any seeps through or

under the VBW below the river bottom will be assessed by the river bottom testing and bulk sediment testing.

- DGTs deployed on every inch of the tested seams is not necessary given the likely mechanism for seeps through the VBW.
  - A CH2M sheet pile expert indicates that the most likely mechanism for leakage through the sheet pile is loss of the Adeka sealant during installation, because of repeated driving of the sheet piling, especially if some of the sealant had already expanded due to contact with water. This mechanism would likely affect at least a few feet of the seam.
  - Given the type of sheet pile installed at the site, unlocking of joints, isolated buckling of the sheet pile, and failure of welded sections is highly unlikely to have occurred, especially post-construction.
  - Given the nature of the sealant, pinhole-type leaks are unlikely.
- As proposed in the work plan, placement of up to five DGTs on each tested seam would result in DGT spacing of one DGT every 3 to 4 feet (as measured from mid-DGT to mid-DGT) if the river column is 15 to 20 feet. This sampler density, assuming an even vertical spacing on the wall, would detect leaks through the tested seam that are 2.5 to 3.5 feet or longer, since the DGTs are 6 inches long.
- The requested deployment of DGTs by the agencies represents 3,465 DGTs (330 seam * 420 inches = 138,600 seam inches; 138,600 seam inches * 0.15 = 20,790 seam inches to be tested; 20,790 seam-inches/6 inches per DGT = 3,465 DGTs). If only 20 feet of VBW seams were tested (that is, the portion of the VBW exposed to the river column), 1,980 DGTs would still be required if every inch of exposed seam must be covered by a DGT.
  - If 40 DGTs could be deployed per day (by SCUBA, one DGT per 15 minutes), the deployment of 1,980 DGTs would take approximately 50 workdays, with another 50 workdays for DGT retrieval. Assuming 5-day workweeks, 20 weeks (5 months) would be required to complete this testing, and 35 weeks would be required for the 3,465 DGT scenario. It will not be feasible to complete such a deployment before the end of 2018.
  - It may be difficult for the laboratory to conduct timely analyses, given the high number of DGTs.
  - The estimated rough order-of-magnitude cost for performing the full-scale test with 1,980 DGTs is estimated to be $1.7 million, given the significant materials, laboratory, and labor costs that would be incurred. Tyco believes that such an expenditure is unnecessary and not commensurate with the level of testing needed for the VBW given the multiple other evaluation methods being implemented.
- Estimates of the flow-through unsealed seams (that is, seams that had theoretically lost all their sealant), based on documentation from the sheet pile manufacturer, is approximately 0.006 gallon per minute (gpm) per seam, or 3.30 gpm for the entire length of the Main Plant Area sheet pile wall (assumes no seams have sealant remaining). For sealed seams, the calculated flow is 0.000019 gpm per seam, or 0.006 gpm for the entire length of the Main Plant Area sheet pile wall.
  - Based on highly conservative assumptions in the 2014 SEDCAM evaluation (CH2M 2014), the total flow rate through the VBW that may result in sediment recontamination to 20 milligrams per kilogram (mg/kg) in 100 years would be 0.15 gpm.

- Assuming 20 feet river column thickness, 0.15 gpm flow rate through wall would occur if 23 seams (460 feet) were completely unsealed, or a 6.9% seam failure rate.
- If 10% of seams were monitored (33 seams), there is a 92% chance that an unsealed seam would be assessed at this failure rate.
- If 15% of seams were monitored (50 seams), there is a 98% chance that an unsealed seam would be assessed at this failure rate.
- Proposed surface water sampling, including assessment of arsenic concentrations in suspended sediment, is proposed for the passive arsenic sampling pilot and full-scale testing and will provide refinement of these estimates. For example, the SEDCAM model assumed that all arsenic-impacted groundwater seeping through the VBW would partition to suspended sediments, which is likely overly conservative.

Considering the agencies' concerns regarding the proposed passive arsenic sampler network, Tyco proposes the following adjustments to the work plan:

- Increase the number of seams tested from 33 (10%) to 50 (15%).
- Select seams to be tested based on review of Construction Completion Report and inspection reports to identify seams with longer driving times during installation, reported deflections, or reported post-installation anomalies.
- On tested seams, deploy DGTs every 3 feet (as measured at the DGT midpoint) along the exposed water column, with the deepest DGT deployed just above the river bottom. Given the likelihood that seeps through the VBW effect on the order of feet of the seam, all tested seams should be adequately monitored by this vertical sampler density.

The WDNR is also concerned that the significance of pore water sampling is not being recognized as an important part of the assessment of the potential for sediment recontamination and surface water impacts due to groundwater migration from the site.

Tyco believes that the ultimate measure of success of the VBW lies in the proposed bulk sediment sampling program agreed to in the AOR. Bulk sediment samples will be collected in 2018 before the Five-Year Review, as described in the BWGMPU. Based on the AOR, bulk sediment samples also will be collected before the 2023 Five-Year Review, after which the number and/or locations of future samples may be proposed by Tyco. Bulk sediment sampling will provide a measure of the effectiveness of the VBW at preventing sediment recontamination, with the two primary potential recontamination pathways being deposition of arsenic-impacted sediments and groundwater migration under or through the wall. As described in the work plan, suspended sediment sampling will be conducted, if necessary, based on DGT results from the VBW to assess the deposition pathway.

Although not required as part of the AOR, pore water and surface water data will be collected from DGTs deployed at the river bottom to assess the groundwater flow pathway. As described in the pilot work plan, surface water data from the river bottom will be compared to chronic and acute surface water quality criteria. Pore water data, which represent the combined effects of sediment deposition and groundwater upwelling (if occurring), will be used to calculate an estimated equilibrium bulk sediment concentration using the Freundlich isotherm previously developed for the site by Dr. Reible (2011) to determine if bulk sediment concentration may exceed 20 mg/kg. Bulk sediment data from the Five-Year Review sampling (which may include arsenic analysis on 6-inch intervals) and suspended sediment sampling also will be used to assess the potential contribution of groundwater migration on sediment concentrations.

In general, the work plan should include specific performance criteria for each component of the pilot test to adequately evaluate the pilot test results. For example, the desired ranges of time-weighted average (TWA) concentrations obtained from diffusive gradients in thin film (DGT) should be stated or explained in the work plan to determine if the pilot test is successful. The percent of total arsenic recovered from DGTs that is considered "effective" should also be stated in the work plan.

Tyco will update the work plan with performance criteria for each component of the pilot test:

- **Arsenic Absorption Study**: The performance criteria will be whether the arsenic concentration measured by the DGT matches, within ± 30% the average concentration present in the water (as measured by the starting and ending water concentrations of total arsenic). Due to the specific arsenic composition presence at the site and the limited amount of data available for DGT performance for organic arsenic species, the performance criteria will be used as a guide; if the performance is determined to be outside ± 30%, a correction factor based on the performance during the arsenic absorption study may be used. Additionally, the more effective binding gel (that is, DGT-measured concentration is closer to water-measured average concentration) at capturing the arsenic species present at the site will be assessed when selecting which binding gel to use.
- **Deployment Time Study**: The performance criteria will be to select a deployment time that can measure arsenic concentrations between 1 microgram per liter (µg/L) (anticipated background concentration) and at least 340 µg/L (the acute arsenic surface water criteria), but ideally as high as 1,000 µg/L. If higher concentrations of arsenic are present, the DGT binding gel capacity will be consumed, and concentrations will be reported as a "greater than" value; this should be sufficient for the full-scale test, as such a result would trigger supplemental surface water sampling.
- **Field Pilot**: Performance criteria for selecting deployment method will include 1) which method most securely adheres the DGT to the wall and 2) which method will be easiest to deploy and retrieve by a SCUBA diver. For selecting the deployment geometry, DGT concentration results will be compared between DGTs positioned parallel to the sheet pile vs. perpendicular to the sheet, with the method that measures the higher arsenic concentration selected. Because of the higher absorptive capacity of the rectangular DGTs, and larger DGT window, Tyco anticipates only testing the rectangular probes during the field pilot. Text and tables will be revised to reflect this proposed change; it is anticipated that multiple deployment times may be tested in place of testing the disk DGTs.

Specific Comments

1) ***Page 2, Conceptual Full-Scale Passive Sampler Testing, paragraph 1:*** *The sentence "Furthermore, passive sampling along the river bottom will be conducted to assess whether the VBW is effective at preventing surface water exceedances at the river bottom." This statement should be amended to also include sediment recontamination: "…to assess whether the VBW is effective at preventing sediment recontamination and surface water exceedances at the river bottom."*

   The work plan will be adjusted as suggested.

2) ***Page 2, Conceptual Full-Scale Passive Sampler Testing, third bullet item****: In the full-scale work plan, clarify that DGT samplers will be co-located with sediment samples at the sediment surface/river bottom interface along the Main Channel and Turning Basin.*

A Freundlich isotherm has already been developed for the site to relate pore water concentrations to bulk sediment concentrations (Reible 2011). DGT deployment likely will not coincide with the planned sediment sampling and may be conducted after the sediment sampling event. The goal of the pore water sampling will be to assess river bottom conditions as close as possible to the VBW. DGTs may be deployed near proposed sediment sampling locations (such as SD-1, SD-2, and SD-3) where the primary goal of pore water sampling near the VBW can be achieved.

3) ***Page 2, Conceptual Full-Scale Passive Sampler Testing, item #4****: Tyco indicates that DGT samplers will be placed at the surface water/river bottom interface. DGT samplers placed to measure pore water TWA arsenic concentrations should be placed in a manner that pore water, and not surface water, will flow through the binding gel.*

   DGT samplers will be placed so that both pore water and surface water concentrations can be measured at each location (that is, a portion of the sediment probe will be below the sediment/surface water interface while a portion will be above this interface). As described in EPA guidance on using DGTs (2017), different sections of a single DGT probe can be extracted for separate analysis of surface water and pore water concentrations. The text will be clarified.

4) ***Page 3, Conceptual Full-Scale Passive Sampler Testing, first paragraph:*** *DGTs should be fastened to the wall to limit interaction between the surface water and binding gel; only groundwater should flow through the binding gel.*

   Per the manufacturer recommendations, DGTs should be placed so flow is across the DGT surface. If there is no or limited flow at the DGT surface, a diffusion boundary layer of stagnant water can develop that makes the conditions required to calculate TWA concentrations invalid. If the agencies require deployment in this way, if there is not flow (that is, there is not a leak, or the DGT seals the leak), then quantitative concentration calculations will not be reliable and the DGT results will simply provide an "absence/presence" type of result that will not inform the parties as to the significance of the leak or the potential that surface water criteria are exceeded. As discussed in the work plan, deployment methods will be tested during the pilot test; the proposed deployment methods will assess water quality within centimeters of the VBW.

5) ***Page 3, Conceptual Full-Scale Passive Sampler Testing, Paragraph 2:*** *Tyco describes how TWA surface water concentrations will be used, but does not provide any information on how TWA pore water concentrations will be used.*

   The text and Figure 2 will be updated to include an assessment of pore water concentrations. The previously established site-specific Freundlich isotherm for arsenic (Reible 2011) specifies a pore water concentration of 255 µg/L would indicate bulk sediment concentrations are approximately 20 mg/kg. If detected DGT pore water concentrations are greater than this pore water threshold concentration, then results will be evaluated as part of the Five-Year Review to evaluate if additional steps are required; otherwise, it will be concluded that the VBW remedy is effective at mitigating nearshore upwelling.

6) ***Page 3, Background on DGT Passive Samplers, paragraph 4:*** *Two configurations of DGT samplers are described. One is a disk with a 2-cm diameter exposure window on one side, equivalent to 3.14 sq.cm. or 0.49 sq.in. The second configuration is rectangular with a 15 cm by 1.8 cm exposure window, equivalent to 27 sq.cm. or 4.2 sq.in. On page 6, in the "Field Pilot Testing" section, the exposed areas of the two different configurations are described as a*

2-inch diameter window and a 6-inch exposure window. Tyco should provide accurate and consistent information on the size/units of the exposed area of the DGTs.

The DGT disks have 3.14 square centimeter (cm) exposure window, with a 2-cm diameter (0.79-inch diameter). The DGT rectangles have a 15-cm (5.9-inch) by 1.8-cm (0.7-inch) exposure window. The text will be corrected/clarified.

7) ***Page 4, Background/Rationale and Goals for Pilot Test, Last Paragraph:*** *This section states that the laboratory components of the pilot test will be used to determine the efficacy of DGTs for the river bottom testing. It is unclear how this goal will be met given that the laboratory components of the pilot test presented in this work plan do not include an assessment of DGTs placed in sediment for porewater analysis. This section also states that the "planned deployment for sediment sampling is standard." The work plan should be revised to state that the planned deployment of DGTs into sediment for porewater sampling is standard.*

Deployment of DGTs on the VBW represent a unique, as-yet-untested deployment method, whereas the deployment of DGTs in sediment for pore water testing is a proven and previously used technology; therefore, the laboratory and field pilot testing are focused on testing the deployment of DGTs on the VBW. Furthermore, a goal of the laboratory pilot testing is to ensure DGTs accurately measure arsenic concentrations when the source waters are composed of varying arsenic species, and therefore is applicable to both the river bottom testing component and the wall testing component. The text will be clarified to indicate that "planned deployment into sediment for pore water sampling is standard."

8) ***Page 4, Background/Rationale and Goals for Pilot Test, last paragraph and Figure 3:*** *The pilot field test appears to only include deployment of DGT samplers on the VBW. The DNR recommends field testing the deployment of samplers at the river bottom interface for both surface and pore water analysis*.

Tyco does not believe that pilot testing of the DGT samplers in sediments is necessary, given the standard deployment procedures and previously proven use of the technology for DGTs in sediments (as described in EPA 2017).

9) ***Page 4, Proposed Pilot Test Methods, last paragraph:*** *Information collected on arsenic speciation in two monitoring wells from 2000 is being used for the basis of selecting wells to collect groundwater samples. These samples will then be used to determine the impact of organic arsenic species on the effectiveness of two different binding gels. Tyco should confirm the speciation by analyzing for the inorganic/organic arsenic concentrations when they collect samples from the monitoring wells used.*

Agreed. Inorganic/organic arsenic speciation concentrations will be analyzed for the groundwater samples collected as stated on page 5 ("Eurofins will analyze the water samples for arsenic (III), arsenic (V), monomethylarsonic acid (MMA), dimethylarinic acid (DMA), and total arsenic using liquid chromatography inductively coupled plasma mass spectrometry.").

10) ***Page 5, Laboratory Site Groundwater Arsenic Absorption Study, Table 1:*** *Groundwater samples from two monitoring wells (MW117M and MW108M) will be collected and used to assess arsenic uptake by DGTs with different binding gels in a laboratory pilot test. This section and Table 1 refer to percentage of organic arsenic in MW010M and MW005M instead of MW117M and MW108M. Provide percentage of organic arsenic for wells that are to be sampled or confirm that the data is not available and that is why adjacent well information is being used.*

MW005M and MW010M were sampled and analyzed for arsenic speciation in 2000 but have since been abandoned, which was necessary to implement remedial actions in the areas of the wells. MW117M and MW108M were recently installed near MW005M and MW010M, respectively, but have not been sampled for arsenic speciation. The text will be clarified. As indicated in the response to Comment 9, the samples collected from MW117M and MW108M will be analyzed for arsenic speciation as part of the laboratory pilot study.

11) ***Page 5, Laboratory Deployment Time Study:*** *This section states that three different contact durations (2, 5, and up to 7 days) will be tested. Guidance document recommendations (U.S. Environmental Protection Agency. 2017. Laboratory, Field, and Analytical Procedures for Using Passive Sampling in the Evaluation of Contaminated Sediments: User's Manual) are for deployment of 1 day. The Toeroek team suggests adding a fourth contact duration of 1 day to the deployment time study.*

CH2M reassessed appropriate deployment times based on the assimilative capacity of the DGT samplers (approximately 258 micrograms for the rectangular probes) and recommends adjusting laboratory deployment times to 1, 2, and 4 days, as the maximum uptake by the DGTs may limit the ability to quantify high concentrations of arsenic if present for longer durations (see table below). The work plan will be updated with these revised contact duration times. Additionally, based on these calculated maximum assimilative capacities, CH2M recommends adjusting the arsenic absorption study deployment time to 4 days and the tested concentration to 200 to 500 µg/L.

Deployment Time (days)	Maximum Concentration to Fill Binding Gel Capacity (µg/L)		
	Arsenic(V)	MW010M Species	MW005M Species
1	2,125	1,574	1,438
2	1063	787	719
3	708	525	479
4	531	393	359
5	425	315	288
6	354	262	240
7	304	225	205

12) ***Page 6, Field Pilot Testing, First Paragraph:*** *This section states that full-scale testing will entail the use of SCUBA divers for deployment, but that the DGTs deployed during the pilot test will be near the top of the water column from the shore or by boat. Although the work plan acknowledges the challenges associated with SCUBA diver deployment, the Toeroek team suggests that the pilot test also include a small percentage of such deployments to minimize troubleshooting and potential delays during the full-scale test.*

Given the costs, scheduling, and safety requirements for SCUBA deployment, CH2M does not recommend SCUBA deployment be part of the pilot field test. However, it is planned that one of CH2M's scientific diver personnel will be part of the pilot test deployment and will provide valuable input on deployment techniques and challenges when done by SCUBA divers during the full-scale test.

13) ***Page 7, Field Pilot Testing, Table 3:*** *Method A and B are referenced in the table but not in the description on pages 6-7. Clarify which method is A and which is B.*

Method A includes using magnets to adhere to the wall, while Method B uses a marine epoxy or adhesive and will be added to the text. As noted in the text, the deployment methods will be modified in the field as necessary. The text will be clarified.

14) ***Figure 1, Proposed Decision Chart for VBW Testing:*** *EPA is unclear why Tyco would calculate an average concentration for each representative area (seam), rather than simply comparing the time-weighted average (TWA) arsenic concentration from each DGT directly to acute and chronic surface water criteria, since surface water criteria need to be met at the point of discharge. Additionally, the subsurface conditions against the VBW are heterogeneous and suggest that averaging would not be appropriate; the wall covers fill and alluvium with a higher conductivity than underlying lacustrine sand and silt; arsenic concentration gradients exist vertically across the different deposits; interlocking joints/seams may separate at any point in the joint/seam due to varying structural loads on the wall from the different deposits and increasing hydraulic pressure with depth, which can create significant local bending moments. Vertical differences in geology, arsenic concentrations, and structural loadings on the wall suggest that it is not appropriate to average TWA arsenic concentrations along the entire seam/joint. Once a measurement of arsenic leaking through the wall at concentrations above background is confirmed, Tyco should proceed to compare the result to surface water criteria and update the SedCAM model.*

Tyco will remove the averaging component of the proposed assessment of DGT barrier wall results and instead will compare each TWA concentration to the surface water criteria. However, Tyco believes it is highly unlikely that interlocking joints/seams will separate at any point given the thickness of the sheet pile. Furthermore, no significant wall deflection has been observed during annual wall surveys that would indicate that deformation of the VBW as described in the comment has occurred. The text will be clarified, and Figure 1 will be adjusted to reflect this change.

15) ***Figure 2:*** *This figure only addresses decisions based on TWA surface water concentrations. The decision tree should include TWA pore water concentrations and subsequent actions.*

As discussed in responses to the General Comment and Specific Comments 2 and 5, Figure 2 will be adjusted to consider pore water concentration results.

16) ***In Attachment 1, Evaluation of Alternatives to the Dye Test****, Tyco states: "7. Pore Water and Surface Water Sampling with Passive Arsenic Sampler: Passive samplers, such as DGTs, could be used to measure pore water arsenic concentrations and surface water concentrations immediately above the river bottom. Because pore water concentrations measured by passive samplers reflect an equilibrium with the surrounding sediments, they will not directly provide information on whether that pore water represents upwelling groundwater. However, collection of surface water data immediately above the sediments would assess potential impacts on surface water from sediments and upwelling. In discussion with the agencies, it was decided that passive arsenic samples from the river bottom would be collected to provide additional data on river bottom conditions."*

The DNR proposed the following language instead*: "7. Pore Water and Surface Water Sampling with Passive Arsenic Sampler. Passive samplers, such as DGTs, could be used to measure pore water arsenic concentrations and surface water concentrations immediately above the river bottom. Because Pore water concentrations measured by passive samplers reflect an equilibrium with the surrounding sediments, they will not directly and this data may*

provide an indication of areas where upwelling of groundwater containing significant arsenic is occurring. provide information on whether that pore water represents upwelling groundwater. However, collection of surface water data immediately above the sediments would assess potential impacts on surface water from sediments and upwelling. In discussion with the agencies, it was decided that passive arsenic samples from the river bottom would be collected to provide additional data on river bottom conditions."

Tyco agrees with the proposed revisions, with the following addition (underlined): and this data may provide an indication of areas where upwelling of groundwater containing significant arsenic, and/or deposition of sediment with high concentrations of arsenic is occurring.

We trust the information provided herein addresses your comments. Note that a revised work plan has not been attached because we anticipate discussing these responses to comments at the May 16, 2018 meeting, after which these draft responses to comments will be finalized and the revised work plan will be submitted. Should you have any questions please do not hesitate to call at 262-951-6888.

Respectfully,

Jeffrey H. Danko
Environmental Geologist

cc: Angela Carey/WDNR
Jim Killian/WDNR
Joseph Janeczek/Johnson Controls
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